

TECHNICAL, REGULATORY and COST ISSUES with INTERCONNECTED BUGS

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- 1. BUG Operation and Interconnection Requirements**
- 2. Preliminary Review of Applicable Standards and Regulations**
- 3. Preliminary Costs of BUG Upgrades (for interconnected operation)**
- 4. Potential BUG Dispatch Limitations- Transmission Lines Congestion**
- 5. Rule 21 Overview**



DEFINITIONS

Isolated Operation

The BUG is **only** connected to a portion or the whole electrical system of the owner's plant or facilities when the portion of, or the whole system is **disconnected** from the utility grid.

If the BUG is not certified for parallel operation a **protection device** (transfer switch) has to be installed and functioning to **prevent** any accidental parallel (interconnected) operation of the BUG.

Parallel Operation

The BUG is connected to the owner's electrical service system (where electrical power is received from the utility) **and** the electrical system of the owner's plant or facilities.

“Islanding” Operation

The BUG is connected to the neighboring portion of the utility grid serving the owner's plant or facilities (which have been isolated for repair purposes) and may act as a “local” generating facility. This situation would be very dangerous and **has to be prevented**.



PARALLEL OPERATION

Operational Requirements

- Frequency control (59.3 to 60.5 Hz)
- IEEE 519 Harmonic Distortion Limit
- Power Factor greater or equal to 0.9, if lower than 0.9 reactive power has to be provided on site
- Synchronization needed (when connecting)
 - within .2 Hz of grid frequency
 - within 10% of grid frequency
 - within 10 degrees of phase angle
- UL1741 Utility Interactive Requirements?



PARALLEL OPERATION

Administrative Process (SCE Example)

- Application completed
- Engineering review (by utility)
- Equipment selection and installation drawings
- Local permits and approvals
- Execution of agreement (with utility)
- Installation of equipment by qualified personnel or contractor



PARALLEL OPERATION

Equipment Needed

- Circuit Breaker
- Synchronization Monitor (manual operation)
- Synchronization Device (automatic operation)
- Protection Devices
 - Loss of Synchronization
 - Power Factor (voltage) regulation
 - Frequency Control
 - Electrical Faults (ground, insulation, etc.)



APPLICABLE STANDARDS AND REGULATIONS

Regulatory and Contractual

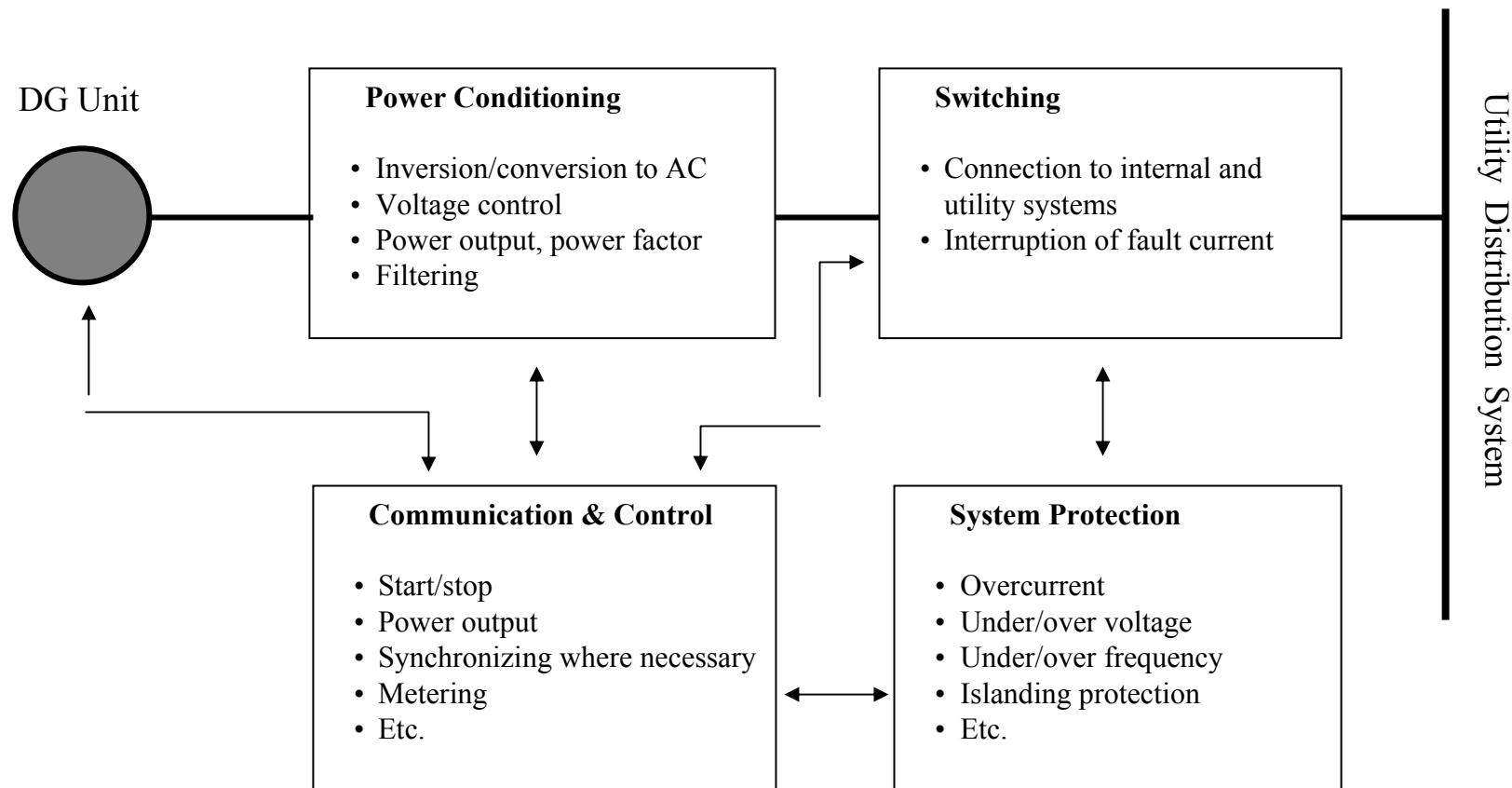
- CEC Rule 21 adopted by the PUC – Filed October 21, 1999 –
Supplementary Filing on January 9, 2001
“Generation Facilities Interconnection”
“Interconnection Agreement”
“Application to interconnect”

Technical and Safety

- IEEE 1547- “Standard for Interconnecting Distributed Resources with Electric Power Systems”
- UL 1741- “Utility Interaction Requirements”
And other applicable UL documents (*will be researched*)
- Appropriate sections of the **National Electric Code**
- Appropriate sections of the local **Building Codes**



GRID INTERCONNECTION REQUIREMENTS (for Distributed Generation)



PRELIMINARY COSTS OF BUG UPGRADES

(Conceptual, for 250 to 500 kW, all costs in \$)

Installation of new Circuit Breaker

Material	1,500
Labor	500

Retrofit of Synchronization Monitor

Material	1,500
Labor	500

BUG Engine Controls Upgrade

Allowance	5,000
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Additional Protection and Metering Devices

Allowance	3,000
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Facilities Wiring Modifications and Tie in

Allowance	2,000
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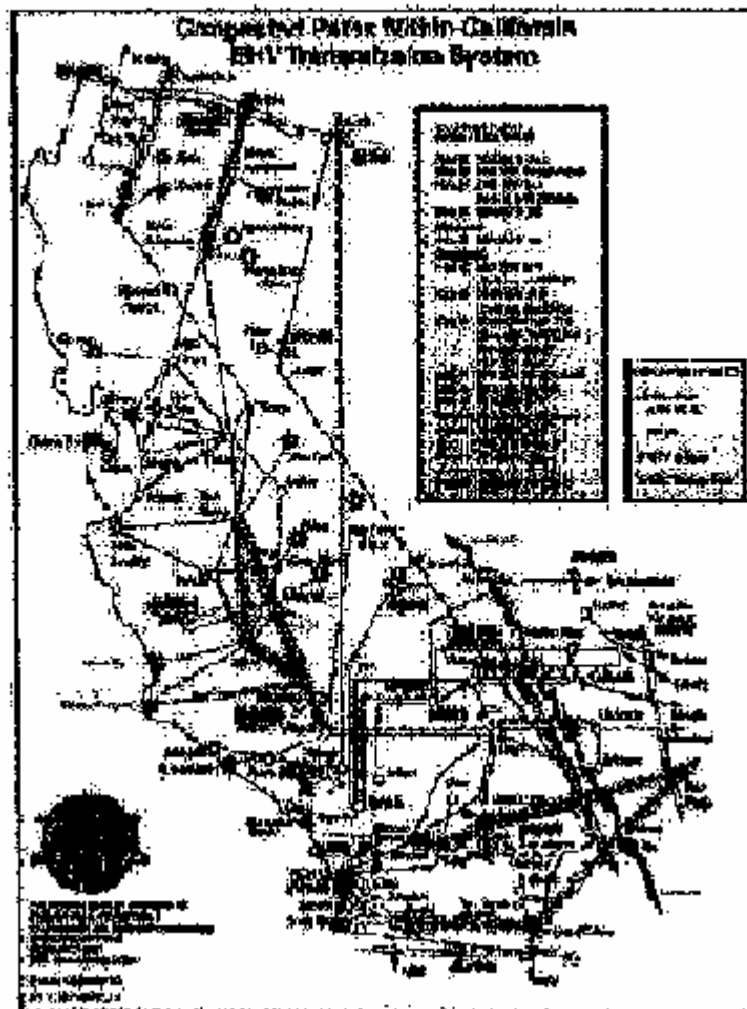
Contingency

7%	<u>1,000</u>
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TOTAL	\$15,000
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POTENTIAL BUG DISPATCH LIMITATIONS – TRANSMISSION LINES CONGESTION



RULE 21 OVERVIEW

Rule 21 was revised in 2000 during a series of workshops coordinated by the California Energy Commission (CEC). A consensus was reached by the main utilities in the State (PG&E, SCE, SDG&E) and new technical and administrative requirements for “Interconnected Generation Facilities” were published.

Filed under Advice 1498 – E – A Rule 21 includes the following sections:

A – Applicability

B – General Rules, Rights, Obligations

C – Generating Facilities Application and Interconnection Process

D – Interconnection Facilities

E – Interconnection Facilities Ownership and Financing

F – Metering, Monitoring and Telemetry

G – Dispute Resolution Process

H – Definitions

I – Initial Process for Application to Interconnect Facilities



THE ULTIMATE BUG...

